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27 July 1948

Progress Report No. 956-16

NAVY DEPARTMENT

BUREAU OF AERONAUTICS

WASHINGTON, D.C.

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INSTRUMENTATION DEVELOPMENT

AND INVESTIGATION OF

PULSATING JET ENGINE CYCLE

Contract NOa(s)-8620

Items 1, 2 and 3

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Azusa, California

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Contract Fulfillment

This report is the sixteenth in a series of progress reports covering the work done on Contract NOa(s)-8620, Items 1, 2 and 3.

I. OBJECT

A. The object of the work undertaken on this contract is to develop and construct equipment suitable for the testing of a pulsating jet engine.

B. The primary object concerns the development of equipment for high-speed recording of pressure and temperature.

C. The final objective is to conduct simultaneously surveys of pressure and temperature, both radially and axially in the combustion chamber and tailpipe of a pulsating jet engine, and to furnish reports thereon.

II. RESUME AND DISCUSSION

A. During the past month work was renewed on the development of the lead sulfide probe for use in the measurement of temperature of pulsejet gases. A new probe, much smaller than the original experimental model, is being built. The end of this new probe will be closed by a filter glass or fused quartz disc so that radiation is received from a gaseous path of definite length. Jacketing is provided for liquid cooling, not only of the shell, but also of the glass filters at the end of the probe. Absorption tests that have been run on carbon tetrachloride indicate that this material is useful as a liquid cooling agent. A telescoping type of shutter is provided, which, when operated by a linear actuator, will make possible exposures of short duration. It is possible that liquid cooling of the filter glasses may not be necessary when this extensible shutter is used. Pictures and tests of this device will be presented in a future report.

B. Work was also started on test equipment to check the validity of the use of radiation in the 2.7 and 4.26 micron bands of carbon dioxide for the measurement of temperature of pulsejet gases. The variation of spectral emissivity with pressure, temperature, and path length must be determined with some certainty. An infrared spectrometer is available for these purposes, and a cell is being developed, which will hold the carbon dioxide gas, and which can be mounted in the optical path of the spectrometer through a periscope. Radiation from the carbon dioxide will enter the monochromator just ahead of the entrance slit. The spectrometer in this setup will operate as an emission-type instrument. A small flow of gas will be sent through the cell. The carbon dioxide gas will be heated in an external heater and piped in through a lagged tube. A smaller heater built into the cell will supplement the external heater to replace heat losses and to make possible a more uniform temperature distribution in the carbon dioxide gas. Heat insulation surrounds the cell heater, which is built in the shape of a long cylinder. A window, liquid-cooled with carbon tetrachloride, is built into the front end of the cell, and a water-cooled piston is built in the rear end. This piston can be positioned so that tests on gas paths of various lengths are possible. This cell is being built to withstand considerable pressure and temperature. It is desirable that pressures be variable from 0 to 50 psi (gage) and that temperatures be carried to 1500°F as a minimum value.

C. All evidence indicates that radiation from carbon dioxide in the 4.26 micron band is nearly gray body in spectral characteristics (refer to Report No. 956-15). This, of course, indicates that this band can be used for temperature measurements of gasoline flames by direct radiometric measurements of intensity. As previously mentioned in a number of reports, the lead sulfide cell does not respond in this longer wavelength region. The lead selenide cell, however, does respond to this 4.26 micron band, but such cells are not yet commercially available. This cell is, according to reports, as fast in response as the lead sulfide cell and has just as great sensitivity. For the present at least, it appears that efforts should be directed toward the use of the 2.7 micron band. Tests as presently planned with the carbon dioxide (CO_2) cell should indicate the degree of usefulness of this shorter wavelength radiation.

D. It appears that satisfactory filters for either of the two wavelength bands in the infrared can be produced from mixtures of suitable powders in proper liquids. These so-called Christiansen filters are, however, not easy to make or to use. They vary somewhat with temperature and do not represent an ideal solution.

SUPPLEMENTARY

INFORMATION

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